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Diffusing Innovations: Implementing the Technology Transfer Act of 1986

Statement of
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Before the
Subcommittee on Technology and Competitiveness
Committee on Science, Space, and Technology
House of Representatives

Mr. Chairman and Members of the Subcommittee:

It is a pleasure to be here this morning to discuss with you our evaluation of the implementation of the federal technology transfer legislation and a related executive order. Specifically, we examined how well federal departments have complied with selected elements of the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480), as amended by the Federal Technology Transfer Act of 1986 (P.L. 99-502), and the April 1987 Executive Order No. 12591: "Facilitating Access to Science and Technology."

Over the last 10 years, the General Accounting Office has examined numerous issues related to federal technology transfer activities. We have provided the results of our efforts in four separate reports and two testimonies before this Subcommittee. (See appendix I.) Our testimony today represents our most comprehensive assessment of the implementation of the current legislation.

BACKGROUND

The term "technology transfer" has not been uniformly defined across the federal departments. It is generally used to refer to one of two principal types of transfer: either a direct transfer, where research is conducted and developed for a specific client group inside or outside the department, or a "spin-off" (that is, a

secondary use), where new technology is marketed for a use other than the one originally intended. The term also applies to a variety of transfer methods ranging from the publication of research results to hands-on technical assistance.

As intended by the Congress, the Stevenson-Wydler Technology Innovation Act of 1980 was the impetus for major change in the interactions between federal laboratories and private industry. The 1980 act gave laboratories the specific mission of transferring new technologies and required them to establish Offices of Research and Technology Applications (ORTAs) to effect the transfers.

The Federal Technology Transfer Act of 1986 amended the Stevenson-Wydler Act and provided incentives to encourage industry, universities, and the federal laboratories to work cooperatively. Specifically, it granted permission for departments to authorize laboratory directors to enter into cooperative research and development agreements (CRDAs) with universities and the private sector. To further encourage technology transfer and the commercialization of federal R&D results, the Technology Transfer Act also required departments to create awards and royalty-sharing programs for federal scientists, engineers, and technicians.

The executive order reiterated many of the provisions of the technology transfer legislation and also provided for an exchange

program for scientists and engineers between the private sector and federal laboratories.

Mr. Chairman, the Subcommittee asked us to develop a plan for assessing federal technology transfer activities. In response, we analyzed the relevant legislation and executive order and designed questionnaires for federal departments and laboratories. We reported our preliminary findings to the Subcommittee in testimony on May 3, 1990.

The questionnaires contained over 100 questions, covering the five areas of: (1) research and technology transfer activities; (2) ORTA characteristics and activities; (3) patents, licenses, and royalties; (4) federal laboratory consortium activities; and (5) laboratory staff, personnel exchanges, and training. Our findings are based on data for fiscal year 1989 collected from 297 federal laboratories representing 10 federal departments.[1] We believe the information we collected in 1989 provides a reasonably accurate determination of the extent to which provisions of the legislation

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[1]In our study, cabinet-level departments (for example, the Departments of Defense (DOD) and Commerce) and the two independent agencies (National Aeronautics and Space Administration (NASA) and the Environmental Protection Agency (EPA)) are treated as "departments." The term "agency" refers to, for example, the Agricultural Research Service of the Department of Agriculture (USDA) or the Food and Drug Administration of the Department of Health and Human Services (HHS). See appendix II for a list of departments and agencies in the study population.

and the executive order had been implemented at that time.[2] The complete results of our survey are provided in our report, Diffusing Innovations: Implementing the Technology Transfer Act of 1986 (GAO/PEMD-91-23, May 1991).

OVERVIEW OF FEDERAL IMPLEMENTATION

Briefly, we found that although all the federal departments that we contacted had taken steps to implement the technology transfer legislation and the executive order, none had achieved full implementation. The level of implementation varied by department and legislative provision. Overall, laboratories in 7 of the 10 departments that we contacted had met at least 50 percent of our measures for implementation. The Environmental Protection Agency, followed by the Department of Energy (DOE), and the Department of Transportation (DOT) had the highest level of implementation, and Interior and the Department of Veterans Affairs (VA) had the lowest.[3]

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[2]All references to the year in our results pertain to the fiscal year.

[3]Our measures of implementation are based on weighted averages of the number of laboratories within a department, as determined by the legislation and executive order, that met the following criteria: (1) received implementation guidance from headquarters; (2) received authorization to enter into cooperative R&D agreements; (3) established Offices of Research and Technology Applications, if required; (4) staffed the ORTAs with at least one full-time position, if required; and (5) established awards, royalty-sharing, and personnel exchange programs.

Some provisions were fully implemented in some departments. For instance, all HHS laboratories had received written implementation guidance and all EPA laboratories had established personnel exchange programs. In some departments, certain provisions had not been implemented at all. For example, not one of the Commerce, Interior, EPA, HHS, USDA, or VA laboratories had established and staffed laboratory-level ORTAs.[4]

Across all 10 departments, nearly 70 percent of the laboratories had received written guidelines for implementing the act. Each of the departments had established an ORTA either at department headquarters or at the laboratory level. However, only slightly more than 40 percent of the large laboratories; that is, those with 200 or more full-time-equivalent scientific, engineering, and technical positions, had ORTAs located on their premises and staffed as mandated by the legislation. Only 44 percent of the laboratory directors had received authority from their department to enter into CRDAs. The majority of the departments had established a distinct technology transfer awards program, although other incentive programs had been created.[5]

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[4]A department head may waive the staffing and funding requirement if he or she submits to the Congress, at the time the President submits the budget, an explanation of the reasons for the waiver and alternate plans for conducting the technology transfer at the agency.

[5]The legislation mandated that each federal department that is making expenditures at a rate of more than $50 million per fiscal year for research and development in its government-operated laboratories develop and implement a cash awards program to reward its scientific, engineering, and technical personnel.

With that overview, I would like to turn now to a more detailed discussion of our findings on the selected provisions and how they have been implemented by the departments and the laboratories. My remarks this morning will focus on four areas: (1) laboratories' receipt of implementation guidance from their parent departments; (2) the establishment and staffing of Offices of Research and Technology Applications; (3) the departments' delegation of authority to laboratories to enter into cooperative research and development agreements; and (4) the establishment of awards programs and other incentives for federal laboratory personnel to engage in technology transfer activities.

PRINCIPAL FINDINGS

Receipt of Departmental Guidance

An important prerequisite to the successful implementation of any legislation is that information about its provisions and the procedures to be used for operationalizing them be communicated to those individuals and organizations that must comply with them. Providing guidance not only has substantive value, but it also serves to show laboratory personnel the commitment of department or agency headquarters to the spirit of the legislation.

The majority of laboratories had received guidance from their parent departments for implementing the act, but we found wide variations among the departments in the completeness of that guidance. For example, all HHS laboratories had received guidance; more than 80 percent of the EPA and USDA laboratories had received either final or draft guidelines, but less than 50 percent of the laboratories under the Departments of Energy and Veterans Affairs had received any type of written guidance.

Establishment and Staffing of ORTAs

Turning to my second point: establishing and staffing offices to effect the transfer of new technologies is a complex process that involves many stages and many variables. Often the participants do not know or understand each other's work environment, procedures, terminology, rewards, or constraints. It has been argued that the transfers are most successful when they involve one-on-one interaction between a committed individual in the laboratory and a counterpart in industry or state or local government. "Enthusiasts" are the ones needed to see a transfer through to completion since doing so is often a time- and energy-consuming process. The Congress recognized this relationship in mandating the establishment of ORTAs and their staffing requirement.

As I stated earlier, every department has established an ORTA. However, the other legislative requirements related to ORTAs have not been fully met. We found that only about two-thirds of the large laboratories had ORTAs at the laboratory level. Of these, about one-third did not have at least one full-time position assigned to staff the ORTA. Forty-eight percent of the staff positions in laboratory-located ORTAs were assigned as a collateral duty, but on the plus side, the ORTA directors, generally, were experienced professionals. Nearly three-fourths had advanced degrees and an average of 21 years of work experience in their specialization.

We also found that all of the laboratory ORTAs carried out, to some degree, the activities that the legislation prescribed for those offices. They were especially active in the dissemination of information on laboratory activities to state and local governments and private industry. Some respondents to our questionnaire reported handling several hundred telephone inquiries for technical assistance. Significant efforts were also devoted to coordinating with other federal ORTAs, evaluating the potential of the laboratory innovations, and providing assistance to the laboratory staff in the transfer of these innovations. For example, several respondents reported that the ORTA was essential to moving their innovation from the laboratory, through the patenting process, to establishing links with potential partners for commercialization.

In summary, our data suggest that the ORTAs that have been established are generally working as the legislation intended. At the same time, however, we have found that some ORTAs are not appropriately located or staffed to meet the objectives of the legislation. Because of the critical role that the ORTA plays in the technology transfer process, we believe that those departments that have not been granted a waiver of the ORTA provision should take immediate steps to locate and staff ORTAs as mandated by the legislation.

Delegation of Authority to Enter Into CRDAs

My third point involves the role of cooperative research and development agreements in successfully transferring new technologies. Before the 1986 act, organizational and legal constraints were among the major reasons put forth to explain why the fruits of federal laboratory research were not being shared with the private sector. Delays in finalizing collaborative arrangements and patent licensing agreements between federal laboratories and private industries were seen to be a consequence of the centralization of this function at department headquarters. The CRDA provisions of the act were intended to obviate these delays by delegating authority to laboratory directors to manage and promote the results of their research.

Our data show that by 1989, approximately 44 percent of the laboratories had been granted the authority to enter into CRDAs. This overall percentage masked the extremes of implementation across the departments. For example, EPA, HHS, NASA, and DOD had given authorization to more than half of their laboratories.[6] The remaining departments had only authorized between 34 and 43 percent of their laboratories to enter into CRDAs.

About 40 percent of all labortories falling under the provisions of the 1986 act had either finalized or were in the process of negotiating cooperative agreements in fiscal year 1989, resulting in 685 draft and final agreements. HHS accounted for the highest percentage of CRDAs (26 percent), followed by DOD (19 percent). The Department of Transportation had no CRDAs.

Cooperative R&D agreements varied with regard to duration, discipline, and partners. The projected life of most CRDAs was more than one year, but less than three; the trend seemed to be toward agreements of longer duration. A wide variety of disciplines, such as biological sciences and computer science, were represented in the CRDAs. Both draft and final CRDAs tended to focus on applied research and testing and evaluation; the least emphasis was given to clinical research. The majority of CRDA partners were U.S. businesses (85 percent of the draft CRDAs and 63

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[6]All of the DOE laboratories in our study population (N=3) reported having been authorized to enter into CRDAs.

percent of final CRDAs), while less than 10 percent were with foreign partners. The types of industrial partners varied as well, including agriculture and medical instruments and supplies.

From our survey results, we also found other types of formal arrangements through which a federal laboratory cooperates with a nonfederal partner in research and development. These include contracts, memorandums of understanding, work-for-other agreements, and grants. Nearly 70 percent of the laboratories reported participation in over 22,000 such formal "non-CRDAs" in 1989.

The linkages established through these types of non-CRDAs between federal laboratories and industry are important, since they assist in the development of products of potential use to the partners or industry at large.

Our analysis found a positive relationship between those laboratories that had received authorization from headquarters to enter into CRDAs and those laboratories that were involved in draft or final CRDAs. That is, the laboratories with authority were more likely to be involved in draft and final CRDAs than those that had not received authorization. This suggests that the new CRDA authority is serving the purposes intended by Congress -- to stimulate R&D cooperation between federal laboratories and the private sector.

Nonetheless, the low level of implementation of this provision is especially troublesome because laboratories were not required to wait to receive authority from headquarters. The legislation encouraged them to proceed, and not delay until headquarters had issued guidelines and regulations. Therefore, the responsibility for the low level of implementation for this provision is shared by the departments and laboratories.

Establishment of Awards and Other Incentives Programs

On my fourth point: the technology transfer legislation, reinforced by the executive order, called on departments to establish incentives to laboratory scientists, engineers, and technical staff to encourage them to share their innovations. Such incentives could include providing (1) awards for inventions or contributions to technology transfer, (2) a share in the profits made on inventions, and (3) personnel exchange programs.

Awards Program

As I mentioned earlier, we found that most of the departments had not complied with this legislative provision to establish a distinct awards program for technology transfer activities. Only three out of the 10 departments we contacted, reported having such a program.

Some of the laboratories, however, have taken the initiative to establish other types of awards programs, independent of their department headquarters. Some have also nominated staff for the "Special Awards for Excellence in Technology Transfer" presented annually by the Federal Laboratory Consortium for Technology Transfer (FLC).

Laboratory awards are granted to inventors, noninventors who contributed toward a patent, and others who have assisted in transferring technology. Seventy-two percent of the laboratories that grant such awards reported that they were established because of an early interest in and support for technology transfer, not in response to the act. The FLC awards are given competitively for excellence in transferring specific technologies from federal laboratories.

Once again, the departments seem to have missed the opportunity to show the laboratories their commitment to both the letter and the spirit of the technology transfer legislation.

Royalty Sharing

With regard to royalties, as you know, before 1986, all royalties earned on inventions derived from federally supported R&D were paid to the U.S. Treasury. The Congress intended to provide a major incentive for technology transfer activities for federal

laboratories and scientists by mandating in the 1986 legislation that a department pay its inventors at least 15 percent of the royalties derived from their inventions, if the invention was produced using agency resources. The remainder of the royalties are to be distributed among the department's laboratories.

We found that among our respondents, royalty-sharing programs had been established in slightly less than one-half of the laboratories, and royalty payments of nearly $800,000 were distributed to 313 inventors in 1989. The efforts of those laboratories that have established royalty-sharing programs are laudable achievements and have provided additional resources to promote technology transfer. Equally important is the incentive royalties give other scientists to pursue technology transfer activities. If the remaining 56 percent of the laboratories were to implement the provisions, these incentives could be significantly increased.

Personnel Exchanges

The technology transfer legislation and the executive order emphasized personnel exchanges as an important mechanism to foster technology transfer. The intent of the legislation was to have federal laboratory scientists spend time in universities, industry, nonprofit organizations, state and local governments, and foreign institutions, and also to have representatives from these same

organizations spend time in federal laboratories for the purpose of technology transfer.

Personnel exchange programs have been instituted in 76 percent of the laboratories, and in 1989, slightly more than 14,000 scientists and engineers had participated in the program. However, these programs are primarily a one-way exchange: 88 percent of them consist of nonfederal scientists visiting federal laboratories. And of that 88 percent, about 70 percent were visiting scientists from U.S. academic institutions and industries. Visiting scientists from foreign countries represented 22 percent of the exchanges.

Our findings indicate that only half the legislative intent of this program is being met. What has resulted is effectively a "visiting scholars program" as opposed to a balanced exchange. The exchange programs seem to have achieved only limited success as an incentive to federal laboratory personnel.

CONCLUDING COMMENTS

In conclusion, our survey has shown that the level of implementation of the technology transfer legislation has been uneven across the federal departments and varies by legislative or executive order provision. We believe that the fact that nearly one-third of the laboratories had not received implementing

instructions from their parent departments and slightly more than one-half of the laboratory directors had not been delegated authority to enter into CRDAs are significant contributory factors to the uneven level of implementation we found.

There have been, however, some notable successes and useful lessons learned. A cadre of dedicated and competent professionals is now working in many laboratory ORTAs to foster technology transfer. More private firms and universities have formed cooperative research and development agreements and established other links to the federal laboratories. And overall, more federal laboratories and their personnel are actively involved in technology transfer activities and are being rewarded for their efforts. There has not been a large increase in the number of patents, licenses, and new technologies from the federal laboratories to the commercial sectors; however, where implementation of the legislation has occurred, it has been relatively effective.

A continuing, concerted commitment to both the substance and the spirit of the technology transfer legislation by the parent departments of federal laboratories is needed for full implementation. Additionally, a comprehensive education and outreach effort will be a necessary, though not a sufficient, step to address the real or perceived barriers to technology transfer that remain. The Congress and the executive branch will have to

continue to monitor the level of implementation through congressional oversight activities and the federal reporting requirements of the legislation.

The information that we have collected on implementation is necessary as a beginning step in examining the overall impact of technology transfer, but it does not, of course, assess that impact. It is important to have full implementation of the legislation before such a comprehensive evaluation of effectiveness can be undertaken. This is especially important in a case where the life cycle of the program's output includes the movement of ideas to the level of innovations and the subsequent movement of innovations to the commercialization of products. We believe it would take at least another year or so before an impact evaluation could be started.

Mr. Chairman, this concludes my opening statement. I would be happy to answer any questions you or other members of the Committee may have.

APPENDIX I

RELATED GAO PRODUCTS

Federal Agencies' Actions to Implement Section 11 of the Stevenson-Wydler Technology Innovation Act of 1980 (GAO/RCED-84-60, Aug. 24, 1984).

Technology Transfer: Constraints Perceived by Federal Laboratory and Agency Officials (GAO/RCED-88-116BR, Mar. 4, 1988).

Technology Transfer: Implementation Status of the Federal Technology Transfer Act of 1986 (GAO-RCED-89-154, May 30, 1989).

"Implementation Status of the Federal Technology Transfer Act of 1986" (GAO/T-RCED-89-47). Testimony before the Subcommittee on Science, Research, and Technology, Committee on Science, Space, and Technology, House of Representatives, June 1, 1989.

"Implementation of the Technology Transfer Act: A Preliminary Assessment" (GAO/T-PEMD-90-4). Testimony before the Subcommittee on Science, Research, and Technology, Committee on Science, Space, and Technology, House of Representatives, May 3, 1990.

Technology Transfer: Federal Agencies' Patent Licensing Activities (GAO/RCED-91-80, Apr. 3, 1991).

APPENDIX II

STUDY POPULATION

Department	Laboratories	
	Number	Percent[a]
National Aeronautics and Space Administration	9	3
Environmental Protection Agency	13	4
Department of Agriculture	59	20
Agricultural Research Service (48)		
Forest Service (11)		
Department of Commerce	27	9
National Institute of Standards (4)		
National Oceanic and Atmospheric Administration (22)		
National Telecommunications and Information Administration (1)		
Department of Defense	69	23
Department of the Army (41)		
Department of the Air Force (11)		
Department of the Navy (17)		
Department of Energy	18	6
Conservation and Renewable Energy (1)		
Defense Programs (4)		
Energy Research (11)		
Fossil Energy (2)		
Department of Health and Human Services	24	8
Alcohol, Drub Abuse, and Mental Health (3)		
Centers for Disease Control (3)		
Food and Drug Administration (6)		
National Institutes for Health (12)		
Department of Interior	28	9
Bureau of Mines (9)		
Bureau of Reclamation (1)		
U.S. Geological Survey (5)		
Fish and Wildlife Service (13)		

Department	Laboratories	
	Number	Percent[a]
Department of Transportation	3	1
U.S. Coast Guard (1) Federal Aviation Administration (1) Federal Highway Administration (1)		
Department of Veterans Affairs	47	16
Veterans Health Services and Research Administration (47)		
Total	297	100%

[a]Percents do not total 100 due to rounding.